WAVES, SOUND & PHYSICAL OPTICS DAY 14: THIN-FILM INTERFERENCE

CED 14.9 · Skill 2.C · FRQ: Qualitative/Quantitative Translation

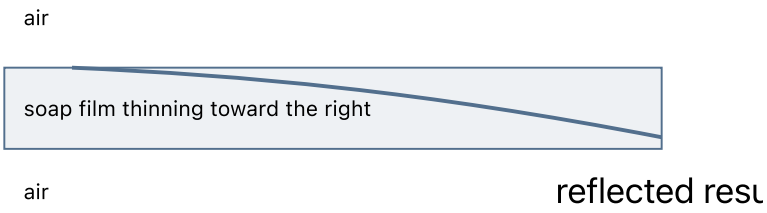
PREDICT

A soap film in air becomes vanishingly thin. In reflected light the thinnest region appears:

A. dark **B. bright white** **C. bright red** **D. unchanged**

Commit before the ray model is revealed.

THINNING FILM; REFLECTED RESULT WITHHELD



TWO SOURCES OF PHASE DIFFERENCE

The lower ray travels an extra optical path $2nt$. A reflection from lower to higher refractive index adds a π phase inversion.

NOTES / REASONING

SELECT THE CONDITION

Relative inversion count	Reflected bright	Reflected dark
one	$2nt = (m + 1/2)\lambda_0$	$2nt = m\lambda_0$
zero or two	$2nt = m\lambda_0$	$2nt = (m + 1/2)\lambda_0$

λ_0 is vacuum wavelength. State the nonnegative integer order m.

Explain why $t \to 0$ is dark for air-soap-air, which has one relative inversion.

CALCULATE A BRIGHT THICKNESS

WE DO A soap film in air has $n = 1.33$. For $\lambda_0 = 532\,\text{nm}$, find the smallest thickness producing bright reflected light. There is one relative inversion.

YOU DO Find the next bright thickness for the same wavelength.

Do not select the condition from the word bright alone. Count inversions first.

LAYER-DIAGRAM CHECK

1. Air (1.00) lies above a film (1.40) on glass (1.60). Mark the inversion at each reflection and state the relative count.

2. For that two-inversion stack, state the reflected bright condition.

3. Explain why a white-light film may reinforce more than one visible wavelength or order.

4. State one way changing t and one way changing n affect the optical path difference.